

SSC DETECTOR SOLENOID DESIGN NOTE #9

TITLE: Flat Annular Head Thicknesses per ASME Code

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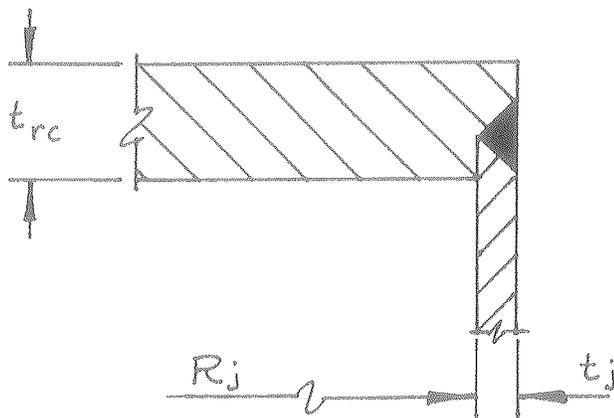
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Introduction

The purpose of this work is to determine the thickness of the flat annular enclosure heads of the vacuum and liquid helium vessels for the SSC detector solenoid.

Assumptions

The cryostat modules are 2 meters in length. The vacuum vessel is 8 meters in length. All cylindrical shells and enclosure plates are 304 stainless steel.



Cross Section of Closure Joint

Solution

The head thicknesses are determined using the procedures outlined in Appendix 9-5 (P. 595-9) in Section VIII Division 1 of the ASME Boiler and Pressure Vessel Code.

$$t_{rc} = 1.414 \sqrt{(PR_s j) / S}$$

where,

$$j = \frac{2St_s^2}{PR_j} - 0.5(t_s + t_j)$$

and,

t_s = thickness of inner vessel wall, in.

t_j = thickness of outer jacket wall, in.

t_{rc} = minimum thickness of enclosure member, in.

R_s = outside radius of inner vessel, in.

R_j = inside radius of jacket, in.

P = design pressure in jacket chamber, psi.

S = maximum allowable stress, psi.

j = jacket space, in.

Vacuum Vessel (15 PSI)

$$j = \frac{2(18.8 \times 10^3)(1.125)^2}{(15)(179.875)} - 0.5(1.125 + 1.25)$$

$$= 16.45 \text{ in.}$$

$$t_{rc} = 1.414 \sqrt{(15)(162.5)(16.45) / (18.8 \times 10^3)}$$

$$= 2.065 \text{ in.}$$

Liquid Helium Vessel (100 PSI)

$$j = \frac{2(18.8 \times 10^3)(2)^2}{(100)(175.25)} - 0.5(2.0 + 1.375)$$
$$= 6.895$$

$$t_{rc} = 1.414 \sqrt{(100)(168.6)(6.895) / (18.8 \times 10^3)}$$
$$= 3.516 \text{ in}$$

Conclusion

Two flat annular heads are necessary to enclose the individual cryostat modules and the vacuum vessel. The thickness of these heads are determined to be 2 inches for the vacuum vessel and 3½ inches for each cryostat module. Therefore, it is likely that the conductor to conductor space between cryostat modules will be 8 inches or greater.